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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

CHARLES L. COMPTON et al.

Group Art Unit: 2613

Examiner: David J. Lee

Serial No.: 10/723,806

Filed: November 26, 2003

For: Apparatus and Method for Providing HFC Forward Path Spectrum

Attorney Docket No.: CCCI0114PUS

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief - Patents
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Sir:

This is an Appeal Brief from the final rejection of claims 1-20 of the Office Action mailed on November 9, 2006, for the above-identified patent application.

I. REAL PARTY IN INTEREST

The real party in interest is Comcast Cable Holdings, LLC ("Assignee"), a corporation organized and existing under the laws of the state of Delaware, and having a place of business at 1500 Market Street, 34th Floor, Philadelphia, Pennsylvania, 19102, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on November 26, 2003, at Reel 014756/Frame 0915.

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II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to the Appellant, the Appellants' legal representative, or the Assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-20 are pending in this application. Claims 1-20 have been rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

A final Office Action was mailed November 9, 2006. A response was mailed January 9, 2007, without amending the claims. There are no outstanding amendments.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to hybrid fiber coax networks. "The modern hybrid fiber coax (HFC) network in its typical implementation includes fiber from the head end to the local network fiber node, and includes coax cable for the final signal distribution through a neighborhood." (Application, pg. 1, ll. 8-10.)

As illustrated, for example, in Appellants' Figure 1, claim 1 provides an apparatus for use in an HFC network (18) to provide an HFC forward path spectrum from a head end (10) to a network fiber node (22). A head end modulator (28) directly receives a switchable digital data signal (from switch 30). This switchable digital data signal is internally processed to produce a modulated optical signal (on fiber 20) that directly drives the network fiber node. **The optical signal is modulated by a radio frequency signal which composes the HFC forward path spectrum**. The optical signal includes a plurality of channel slots. The radio frequency signal carries the switchable digital data signal in the plurality of channel slots. (*See also, for example*, pg. 2, ll. 11-23; pg. 4, ln. 20-pg. 5, ln. 31.)

Independent claim 8 provides a method for use in an HFC network to provide an HFC forward path spectrum from the head end (10) to a network fiber node (22). With regard as well to Appellants' Figure 4, a switchable digital data signal (from switch 30) is directly received at a head end modulator (28), as in block 70. The switchable digital data signal is processed, at the head end modulator, to produce a modulated optical signal (on fiber 20) that directly drives the network fiber node, as in block 74. **The optical signal is modulated by a radio frequency signal which composes the HFC forward path spectrum**, as in block 72. The optical signal includes a plurality of channel slots. The radio frequency signal carries the switchable digital data signal in the plurality of channel slots. (*In addition, for example, see*, pg. 3, ll. 14-20; pg. 6, ll. 16-20.)

Independent claim 15, as seen, for example, in Appellants' Figure 3, provides a system for use in an HFC network (18) to provide an HFC forward path spectrum from the head end (10) to a plurality of network fiber nodes (22, 44, 54). The head end includes a plurality of modulators (28, 40, 50). Each modulator directly receives a switchable digital data signal (from switch 30) and internally processes the switchable digital data signal to produce a modulated optical signal (on fibers 20, 42, 52, respectively) that directly drives an associated network fiber node. **The optical signal is modulated by a radio frequency signal which composes the HFC forward path spectrum.** The optical signal includes a plurality of channel slots. The radio frequency signal carries the switchable digital data signal in the plurality of channel slots. Each individual modulator processes its received switchable digital data signal to dynamically allocate bandwidth to different services to provide an essentially narrowcast approach among the plurality of modulators. (*In addition, for example, see*, pg. pg. 3, ln. 24-pg. 4, ln. 2; pg. 6, ll. 1-15.)

As described in the specification, the entire forward path signal spectrum is produced in the modulator, dispensing with the need for combining signals, as in the prior art.

> Modulator 28 advantageously produces the entire or essentially entire HFC forward path spectrum. For example, the spectrum may be the 50-750 megahertz spectrum. The produced forward path spectrum directly drives fiber node 22 and

> traditional RF combining networks are not required. Accordingly, the flexibility limitations associated with traditional RF combining networks are not present. Modulator 28 may process the digital data signal to dynamically allocate bandwidth to different services. This approach produces a total narrowcast arrangement, as opposed to the complex combination of broadcast and narrowcast distribution associated with traditional RF combining networks.
>
> (Application, pg. 5, ll. 9-17.)

Further refinements of Appellants' invention are provided in the dependent claims. For example, claims 3 and 10 further provide that the head end modulator processes the switchable digital data signal to dynamically allocate bandwidth to different services. Bandwidth allocation is accomplished, for example, by mapping spectrum requests into spectrum allocations. (*See, for example*, Application, pg. 3, ll. 1-5; pg. 5, ll. 9-19.)

Claims 6, 13, and 19 provide that the switchable digital data signal is received as a single digital data signal input. "Figure 1 illustrates modulator 28 receiving a single switched digital data signal." (Application, pg. 5, ln. 21. *See also, for example*, Application, pg. 3, ll. 6-13.)

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-3, 5, 6, 8-10, 12, 13, and 20 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Pub. No. 2003/0196491 to Deng *et al.* (henceforth, Deng). Claims 7, 14-16, 18, and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Deng.

VII. ARGUMENT

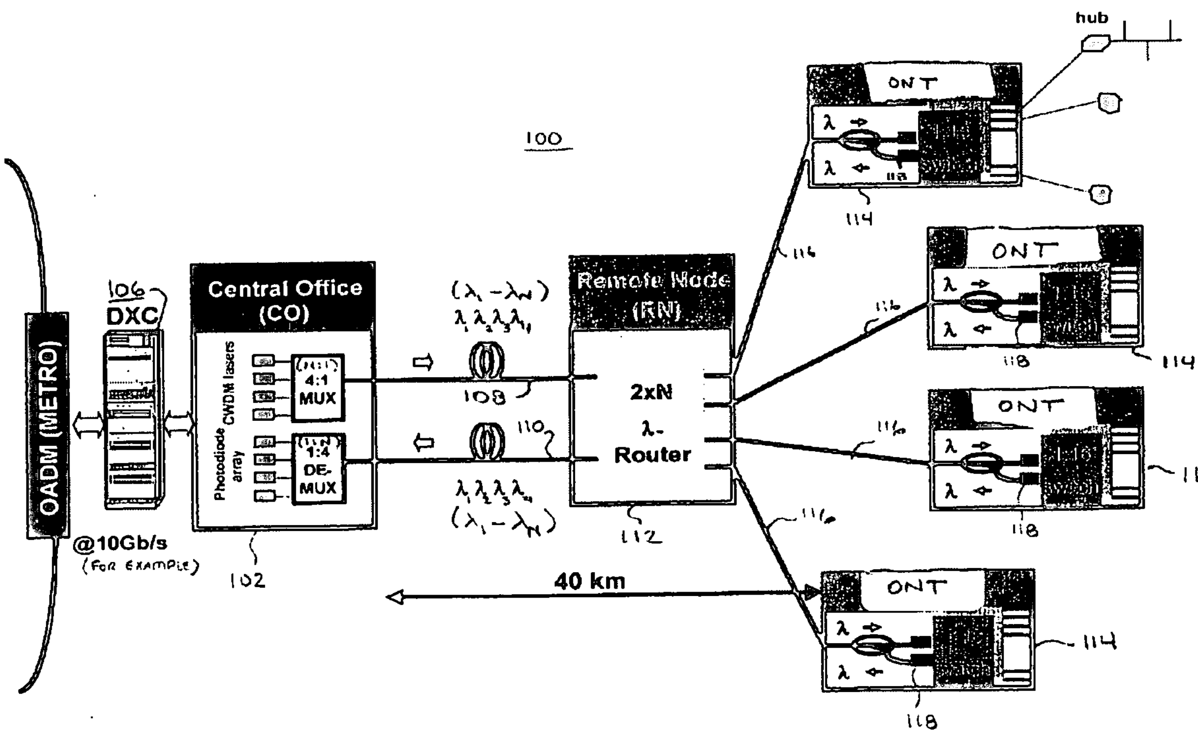
Appellants believe claims 1-20 are patentable over Deng and respectfully request review by the Board in light of the following arguments.

A. Claims 1-3, 5, 6, 8-10, 12, 13, and 20 Are Patentable Under 35 U.S.C. § 102(e) Over Deng

Claim 1 provides, *inter alia*, a head end modulator which receives a switchable digital data signal. This switchable digital data signal is internally processed by the modulator to produce an optical signal that is modulated by a radio frequency signal. The radio frequency signal composes the HFC forward path spectrum.

Independent claim 8 is a method for providing an HFC forward path spectrum from a head end which includes, *inter alia*, processing a received switchable digital signal at a head end modulator to produce an optical signal modulated by a radio frequency signal. The radio frequency signal composes the HFC forward path spectrum.

The Examiner rejected claims 1 and 8 as anticipated by Deng. Deng is directed to a "Passive Optical Network Employing Coarse Wavelength Division Multiplexing." As is known in the art, wavelength division multiplexing (WDM) systems use a plurality of modulators to generate a plurality of signals at different frequencies. A multiplexer in the transmitter joins these signals together for transmission over an optical medium. A demultiplexer at the receiver splits the signals apart. Deng's Figure 4, reproduced below, illustrates Deng's Central Office transmitting system.



In Deng's system, a plurality of modulators are used, each operating at a different frequency, to generate a portion of the forward path spectrum (optical fiber in downstream direction 108).

Although in the exemplary architecture depicted in FIG. 4, the signals exchanged between upstream node 102 and the metropolitan area network are converted from optical to electrical and back again to optical, it should be noted that the teachings of the present invention are equally applicable to all optical networks in which no electrical conversion is needed for aggregation and routing of the constituent information signals. In any event, and with continued reference to FIG. 4, it will be seen that each signal received from cross connect 106 corresponds to a respective coarsely wavelength division multiplexed optical signal to be routed to subscribers downstream via a plurality of fibers. For clarity and ease of explanation, only one fiber in each direction (to and from upstream node 102)--indicated generally at 108 and 110, respectively, is shown representing connection to a single

> illustrative remote node (RN) 112 serving a corresponding group of passive optical network terminals (ONTs) 114 which, in turn, each serve a corresponding plurality of subscribers.
>
> (Deng, ¶ 26.)
>
> In any event, and as seen in FIG. 4, a first plurality of WDM optical signals within an optical wavelength band of optical fiber 108 are transmitted over optical fiber 108 in the downstream direction toward remote node 112. Likewise, a second plurality of WDM optical signals within the optical wavelength band of optical fiber 110 are transmitted from remote node 112 toward upstream node 102. Each plurality of CWDM optical signals employs N optical wavelengths, and these wavelengths may, but need not be, the same in both upstream and downstream directions. By way of illustrative example, in an eight wavelength system, λ_1-λ_8 may be transmitted in the downstream direction over fiber 108 and λ_1-λ_8 may, at the same time, be transmitted in the upstream direction over fiber 110. In the illustrative network shown in FIG. 4, a respective one of four wavelengths (λ_1-λ_4) supplied via fiber 108 is transmitted from the remote node RN 112 to a corresponding ONT 114 via a dedicated fiber link 116.
>
> (Deng, ¶ 27.)

According to Deng, a plurality of modulators (CWDM lasers in the central office) are used to modulate a plurality of data streams from cross connect 106. A multiplexer (4:1 MUX in the central office) is used to combine the resulting optical signals into the multi-wavelength output sent along optical fiber 108 to remote node 112. Remote node 112 then splits the multi-wavelength signal into its constituent wavelength components, each of which is passed to one dedicated fiber link 116.

Deng's system is entirely different than Appellants' invention. In Appellants' invention, a radio frequency signal making up the entire forward path spectrum is processed by a modulator to produce the optical signal. In Deng's system, a plurality of separate digital streams are individually modulated at separate frequencies to generate separate optical signals which must be combined by a multiplexer. Deng neither teaches nor fairly suggests Appellants' invention in which "the optical signal [is] modulated by a radio frequency signal,

wherein the radio frequency signal composes the HFC forward path spectrum" as provided by claim 1 and claim 8.

Addressing the Examiner's argument, the Examiner's sole support that Deng discloses the relevant portion of the claimed invention is "see paragraph 0031." (Final Office Action, November 9, 2006, pg. 2.) This paragraph is reproduced below.

> From the foregoing, it will be understood that each ONT 114 receives its designated CWDM signal from RN 112, via a dedicated fiber link 116. By way of illustrative example, fiber link 116 may carry a single WDM channel modulated at a data rate of, say, 2.5 Gb/s for gigabit Ethernet applications (GbE). Depending upon the needs of the subscribers associated with a particular ONT, a flexible suite of data and/or voice communication services may be provided by the owner or operator of the CWDM-PON of the present invention. Illustratively, the downstream WDM channel may be time division multiplexed using a 1:N switch to provide a plurality of lower rate data channels to the respective subscribers. Thus, for example, a 1:16 switch might be configured in the downstream direction to divide the WDM channel into 16 TDM time slots, each carrying 155 Mb/s. Likewise, in the upstream direction, the aggregated traffic originating from each of these subscribers may also be received via transmission over assigned time slots and passed to an N:1 (e.g., 16:1) switch and transmitted to the upstream node, for appropriate routing, as the upstream WDM channel received by RN 112 via the ONT transmitter 116.

As discussed above, Deng discloses separate digital signals fed to separate modulators which generate separate optical signals at different wavelengths. These signals are combined in the central office to produce the transmitted optical signal. At a remote node — remote from the central office — the transmitted optical signal is divided into its separate constituent wavelength components. The remote node then sends each constituent optical signal to a different optical network terminal (ONT 114). The Examiner has chosen to focus on what happens after the remote node (RN 112) divides this signal into its plurality of constituent wavelength signals. However, each of these individual constituent wavelength signals is not the forward path spectrum of Appellants' invention.

Claim 1 and claim 8 are patentable over Deng. Claims 2-7 and 20 depend from claim 1 and claims 9-14 depend from claim 8. Therefore, claims 2-7, 9-14, and 20 are also patentable over Deng.

1. Claims 3 and 10 Are Separately Patentable <u>Under 35 U.S.C. § 102(e) Over Deng</u>

Claim 3, which depends from claim 1, and claim 10, which depends from claim 8, further provide that "the head end modulator processes the switchable digital data signal to dynamically allocate bandwidth to different services." The Examiner rejected claims 3 and 10 as anticipated by Deng. The Examiner's sole justification is "the digital data signal from 106 is allocated by wavelength." (Final Office Action, November 9, 2006, pg. 3.) There is no disclosure in Deng for dynamically allocating bandwidth for any purpose, let alone to provide different services.

Claims 3 and 10 are therefore separately patentable over Deng.

2. Claims 6 and 13 Are Separately Patentable <u>Under 35 U.S.C. § 102(e) Over Deng</u>

Claim 6, which depends from claim 1, and claim 13, which depends from claim 8, further provide that "the switchable digital data signal is received as a single digital data signal input." The Examiner rejected claims 3 and 10 as anticipated by Deng. The Examiner's sole justification is "from 106 of fig. 4." (Final Office Action, November 9, 2006, pg. 3.)

Deng teaches just the opposite of the Examiner's implication. Deng discloses that a plurality of digital signals are provided to a plurality of modulators.

> In any event, and with continued reference to FIG. 4, it will be seen that <u>**each signal received from cross connect 106 corresponds to a respective coarsely wavelength division multiplexed optical signal**</u> to be routed to subscribers

> downstream via a plurality of fibers. For clarity and ease of explanation, only one fiber in each direction (to and from upstream node 102)--indicated generally at 108 and 110, respectively, is shown representing connection to a single illustrative remote node (RN) 112 serving a corresponding group of passive optical network terminals (ONTs) 114 which, in turn, each serve a corresponding plurality of subscribers.
>
> (Deng, pg. 3, ¶ 26 (emphasis added).)
>
> Claims 6 and 13 are therefore separately patentable over Deng.

B. Claims 7, 14-16, 18, and 19 Are Patentable Under 35 U.S.C. § 103(a) Over Deng And Appellants' Disclosure

Claim 15 provides a system for use in an HFC network to provide an HFC forward path spectrum from the head end which includes a plurality of head end modulators. Each modulator directly receives a switchable digital data signal and internally processes the switchable digital data signal to produce a modulated optical signal that directly drives an associated network fiber node. The optical signal is modulated by a radio frequency signal. The radio frequency signal composes the HFC forward path spectrum and includes a plurality of channel slots. The radio frequency signal carries the switchable digital data signal in the plurality of channel slots.

The Examiner rejected claim 15 as an obvious combination of Deng and unspecified "admitted" prior art. The Examiner admits that Deng does not disclose Appellants' plurality of head end modulators.

> Deng does not specifically disclose a plurality of modulators to receive the digital data signal and produce the HFC forward path spectrum. However, it is well known in view of the admitted prior art that using a plurality of modulators, instead of a single modulator, to transmit a forward path spectrum is well known in the art.
>
> (Final Office Action, November 9, 2006, pg. 4.)

The Examiner points to no disclosure in Appellants' application to support his conclusion. Moreover, even if some support existed, "using a plurality of modulators to transmit a forward path spectrum" is not the invention claimed by Appellants. Appellants claim that each of a plurality of modulators generates an optical signal modulated by a radio frequency signal that composes the HFC forward path spectrum. Neither Appellants' background discussion nor Deng teach or fairly suggest Appellants' modulators.

In addition, claim 15 provides that "each individual modulator processes its received switchable digital data signal to dynamically allocate bandwidth to different services to provide an essentially narrow cast approach among the plurality of modulators." The Examiner asserts this limitation is disclosed in Deng, providing as his only support "the digital data signal from 106 is allocated by wavelength." (Final Office Action, November 9, 2006, pg. 4.) There is no disclosure in Deng for dynamically allocating bandwidth for any purpose, let alone to provide different services.

Claim 15 is patentable over any combination of Deng and Appellants' background discussion. Claims 16-19, which depend from claim 15, are therefore also patentable.

The fee of $500 as applicable under the provisions of 37 C.F.R. § 41.20(b)(2) is enclosed. Please charge any additional fee or credit any overpayment in connection with this filing to our Deposit Account No. 02-3978.

Respectfully submitted,

CHARLES L. COMPTON et al.

By: ______________________
Mark D. Chuey, Ph.D.
Registration No. 42,415
Attorney/Agent for Applicant

Date: May 31, 2007

BROOKS KUSHMAN P.C.
1000 Town Center, 22nd Floor
Southfield, MI 48075-1238
Phone: 248-358-4400
Fax: 248-358-3351

Enclosure - Appendices

VIII. CLAIMS APPENDIX

Claims 1-20, pending on appeal in this case, are as follows:

1. An apparatus for use in a hybrid fiber coax (HFC) network to provide an HFC forward path spectrum from the head end to a network fiber node, the apparatus comprising:

a head end modulator directly receiving a switchable digital data signal and internally processing the switchable digital data signal to produce a modulated optical signal that directly drives the network fiber node, the optical signal being modulated by a radio frequency signal, wherein the radio frequency signal composes the HFC forward path spectrum and includes a plurality of channel slots, and wherein the radio frequency signal carries the switchable digital data signal in the plurality of channel slots.

2. The apparatus of claim 1 wherein the head end modulator generates an analog optical signal for the network fiber node.

3. The apparatus of claim 1 wherein the head end modulator processes the switchable digital data signal to dynamically allocate bandwidth to different services.

4. The apparatus of claim 1 wherein the switchable digital data signal is received in the form of a 1GigE signal.

5. The apparatus of claim 1 wherein the switchable digital data signal is received in the form of a 10GigE signal.

6. The apparatus of claim 1 wherein the switchable digital data signal is received as a single digital data signal input.

7. The apparatus of claim 1 wherein the switchable digital data signal is received as a plurality of digital data signal inputs.

8. A method for use in a hybrid fiber coax (HFC) network to provide an HFC forward path spectrum from the head end to a network fiber node, the method comprising:

directly receiving a switchable digital data signal at a head end modulator; and

processing the switchable digital data signal, at the head end modulator, to produce a modulated optical signal that directly drives the network fiber node, the optical signal being modulated by a radio frequency signal, wherein the radio frequency signal composes the HFC forward path spectrum and includes a

plurality of channel slots, and wherein the radio frequency signal carries the switchable digital data signal in the plurality of channel slots.

9. The method of claim 8 further comprising:

generating an analog optical signal, with the head end modulator, for the network fiber node.

10. The method of claim 8 wherein the head end modulator processes the switchable digital data signal to dynamically allocate bandwidth to different services.

11. The method of claim 8 wherein the switchable digital data signal is received in the form of a 1GigE signal.

12. The method of claim 8 wherein the switchable digital data signal is received in the form of a 10GigE signal.

13. The method of claim 8 wherein the switchable digital data signal is received as a single digital data signal input.

14. The method of claim 8 wherein the switchable digital data signal is received as a plurality of digital data signal inputs.

15. A system for use in a hybrid fiber coax (HFC) network to provide an HFC forward path spectrum from the head end to a plurality of network fiber nodes, the system comprising:

a plurality of head end modulators, each modulator directly receiving a switchable digital data signal and internally processing the switchable digital data signal to produce a modulated optical signal that directly drives an associated network fiber node, the optical signal being modulated by a radio frequency signal, wherein the radio frequency signal composes the HFC forward path spectrum and includes a plurality of channel slots, and wherein the radio frequency signal carries the switchable digital data signal in the plurality of channel slots,

wherein each individual modulator processes its received switchable digital data signal to dynamically allocate bandwidth to different services to provide an essentially narrow cast approach among the plurality of modulators.

16. The system of claim 15 wherein each head end modulator generates an analog optical signal for the associated network fiber node.

17. The system of claim 15 wherein the switchable digital data signal is received in the form of a 1GigE signal.

18. The system of claim 15 wherein the switchable digital data signal is received in the form of a 10GigE signal.

19. The system of claim 15 wherein the switchable digital data signal is received as a single digital data signal input.

20. The apparatus of claim 1 wherein the plurality of channel slots are in the form of frequency ranges.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.